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Multidisciplinary Characterization of Chloroethene Subsurface Contamination in Sedimentary Bedrock

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The North Bohemia Carcass Disposal Plant (SAP) Mimoň is one of the largest and most intensive areas of soil and groundwater chloroethene contamination in the Czech Republic. Perchlorethylene (PCE) was used in operations at the SAP Plant from 1963 to 1988. The PCE usage was about 160-200 tons per year; with a total consumption of 4,250 tons during the 25-year period. Frequent operational leakages caused a large chloroethene plume in a sandstone aquifer. The plume spread downgradient from the factory, following the dominant groundwater flow direction. The plume migration was accelerated by pumping of water supply wells downstream from the source area. Contamination of drinking water from these water supply wells was discovered in 1988 as the first indication of contamination from the site.

The total quantity of PCE released was estimated to range from 149-246 tons, with the confidence interval of 95 percent. The maximum contamination levels were identified between 2 and 20 meters depth in an area of about 10 hectares, in Quaternary sediments and weathered Cretaceous sandstones. The groundwater plume was found to be impacting the neighbouring river. Ten years (1997-2007) of intensive pump-and-treat was applied at the site, which decreased the plume extent significantly. Approximately 100 tons of PCE was extracted from the site subsurface and plume extent reduced to less than 1 hectare.

A combination of investigative methods was applied at the site in 2005-2007 to obtain more detailed information about contamination stratification and DNAPL distribution in the sedimentary bedrock. The methods used were: (1) groundwater sampling from multi-level sampling points, (2) soil probing with MIP, (3) tree core sampling, (4) geophysical methods, and (5) soil core testing with hydrophobic dye.

An innovative method of tree core sampling was used to detect chloroethenes in wood samples, which very precisely delineated groundwater contamination in the shallow aquifer. The survey revealed that sedimentary structures highly influenced DNAPL migration in the relatively homogenous sandstone bedrock. This finding led to creation of a new conceptual model of the site, which will be used in determining the final clean-up step.

Part of the work was performed within the BIOTOOL Project, funded by EC (nr. 003998, Sixth Framework Program; http://www.gbf.de/biotools/index.html). The objective of BIOTOOL is to create monitoring tools for determining the distribution and predicting evolution of contaminated soil and groundwater.